

Preface

This report documents the formulation of program Regres of the Orbit Determination Program (ODP) of the Jet Propulsion Laboratory (JPL). Program Regres calculates the computed values of observed quantities (*e.g.*, doppler and range observables) obtained at the tracking stations of the Deep Space Network (DSN). It also calculates media corrections for the computed values of the observables and partial derivatives of the computed values of the observables with respect to the solve-for parameter vector \mathbf{q} . The Orbit Data Editor (ODE) obtains the actual quantities that are observed by the DSN. These quantities are used to calculate the “observed” values of the DSN data types using the formulation given in this report. These “observables” are given to program Regres on the OD file. The definitions of the observed values of the DSN data types calculated in the ODE and the computed values of the DSN data types calculated in program Regres are the same. The estimation programs of the ODP set fit the computed values of the observables to the observed values of the observables in a least squares sense by differentially correcting the values of the solve-for parameters. This process uses the observed-minus-computed residuals and the partial derivatives of the computed values of the observables with respect to the solve-for parameter vector \mathbf{q} calculated in program Regres. The resulting estimated values of the solve-for parameters determine the trajectory of the spacecraft.

The last external report that documented the Regres formulation was Moyer (1971) (see Section 14, References). That report gave the complete formulation of the ODP. This report gives the formulation for program Regres only. I started working on the Regres formulation when I arrived at JPL in 1963. Prior to publication of this document, the Regres formulation was contained in parts of Moyer (1971), and in many JPL-internal memoranda. The purpose of writing this document was to place the entire Regres formulation in a widely available external document. It will be used in the Next-Generation Navigation Software, which is currently under development at JPL. Also, the formulation is available and can be used by any organization that is developing an ODP. It applies for navigating a spacecraft anywhere in the Solar System.

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